

CLAIMS

WE CLAIM:

1. A transgenic plant cell transformed by a Protein Kinase Stress-Related Protein (PKSRP) coding nucleic acid, wherein expression of the nucleic acid in the plant cell results in increased tolerance to an environmental stress as compared to a wild type variety of the plant cell and wherein the PKSRP is selected from the group consisting of: Protein Kinase-6 (PK-6); Protein Kinase-7 (PK-7); Protein Kinase-8 (PK-8); Protein Kinase-9 (PK-9); Casein Kinase homologue (CK-1); Casein Kinase homologue-2 (CK-2); Casein Kinase homologue-3 (CK-3); MAP Kinase-2 (MPK-2); MAP Kinase-3 (MPK-3); MAP Kinase-4 (MPK-4); MAP Kinase-5 (MPK-5); Calcium dependent protein kinase-1 (CPK-1); Calcium dependent protein kinase-2 (CPK-2); and orthologs thereof.
2. The transgenic plant cell of Claim 1, wherein the PKSRP is selected from the group consisting of PK-6 as defined in SEQ ID NO:27; PK-7 as defined in SEQ ID NO:28; PK-8 as defined in SEQ ID NO:29; PK-9 as defined in SEQ ID NO:30; CK-1 as defined in SEQ ID NO:31; CK-2 as defined in SEQ ID NO:32; CK-3 as defined in SEQ ID NO:33; MPK-2 as defined in SEQ ID NO:34; MPK-3 as defined in SEQ ID NO:35; MPK-4 as defined in SEQ ID NO:36; MPK-5 as defined in SEQ ID NO:37; CPK-1 as defined in SEQ ID NO:38; and CPK-2 as defined in SEQ ID NO:39.
3. The transgenic plant cell of Claim 1, wherein the PKSRP coding nucleic acid is selected from the group consisting of PK-6 as defined in SEQ ID NO:14; PK-7 as defined in SEQ ID NO:15; PK-8 as defined in SEQ ID NO:16; PK-9 as defined in SEQ ID NO:17; CK-1 as defined in SEQ ID NO:18; CK-2 as defined in SEQ ID NO:19; CK-3 as defined in SEQ ID NO:20; MPK-2 as defined in SEQ ID NO:21; MPK-3 as defined in SEQ ID NO:22; MPK-4 as defined in SEQ ID NO:23; MPK-5 as defined in SEQ ID NO:24; CPK-1 as defined in SEQ ID NO:25; and CPK-2 as defined in SEQ ID NO:26.
4. The transgenic plant cell of Claim 1, wherein the PKSRP coding nucleic acid hybridizes under stringent conditions to a sequence of SEQ ID NO:14, SEQ ID NO:15, SEQ ID NO:16, SEQ ID NO:17, SEQ ID NO:18, SEQ ID NO:19, SEQ ID NO:20, SEQ ID NO:21, SEQ ID NO:22, SEQ ID NO:23, SEQ ID NO:24, SEQ ID NO:25, or SEQ ID NO:26.

5. The transgenic plant cell of Claim 1, wherein the environmental stress is selected from the group consisting of salinity, drought and temperature.
6. The transgenic plant cell of Claim 1, wherein the plant is a monocot.
7. The transgenic plant cell of Claim 1, wherein the plant is a dicot.
8. The transgenic plant cell of Claim 1, wherein the plant is selected from the group consisting of maize, wheat, rye, oat, triticale, rice, barley, soybean, peanut, cotton, rapeseed, canola, manihot, pepper, sunflower, tagetes, solanaceous plants, potato, tobacco, eggplant, tomato, Vicia species, pea, alfalfa, coffee, cacao, tea, Salix species, oil palm, coconut, perennial grass and forage crops.
9. A transgenic plant comprising a plant cell according to any of Claims 1-8.
10. A seed produced by a transgenic plant comprising a plant cell according to any of Claims 1-8, wherein the seed is true breeding for an increased tolerance to environmental stress as compared to a wild type variety of the plant cell.
11. An agricultural product produced by the transgenic plant or seed of Claims 9 or 10.
12. An isolated Protein Kinase Stress-Related Protein (PKSRP) wherein the PKSRP is selected from the group consisting of Protein Kinase-6 (PK-6); Protein Kinase-7 (PK-7); Protein Kinase-8 (PK-8); Protein Kinase-9 (PK-9); Casein Kinase homologue (CK-1); Casein Kinase homologue-2 (CK-2); Casein Kinase homologue-3 (CK-3); MAP Kinase-2 (MPK-2); MAP Kinase-3 (MPK-3); MAP Kinase-4 (MPK-4); MAP Kinase-5 (MPK-5); Calcium dependent protein kinase-1 (CPK-1); Calcium dependent protein kinase-2 (CPK-2); and orthologs thereof.
13. The isolated PKSRP of Claim 12, wherein the PKSRP is selected from the group consisting of PK-6 as defined in SEQ ID NO:27; PK-7 as defined in SEQ ID NO:28; PK-8 as defined in SEQ ID NO:29; PK-9 as defined in SEQ ID NO:30; CK-1 as defined in SEQ ID NO:31; CK-2 as defined in SEQ ID NO:32; CK-3 as defined in SEQ ID NO:33; MPK-2 as defined in SEQ ID NO:34; MPK-3 as defined in SEQ ID NO:35; MPK-4 as defined in SEQ ID NO:36; MPK-5 as defined in SEQ ID NO:37; CPK-1 as defined in SEQ ID NO:38; and CPK-2 as defined in SEQ ID NO:39

14. An isolated Protein Kinase Stress-Related Protein (PKSRP) coding nucleic acid, wherein the PKSRP coding nucleic acid codes for a PKSRP selected from the group consisting of PK-6 as defined in SEQ ID NO:14; PK-7 as defined in SEQ ID NO:15; PK-8 as defined in SEQ ID NO:16; PK-9 as defined in SEQ ID NO:17; CK-1 as defined in SEQ ID NO:18; CK-2 as defined in SEQ ID NO:19; CK-3 as defined in SEQ ID NO:20; MPK-2 as defined in SEQ ID NO:21; MPK-3 as defined in SEQ ID NO:22; MPK-4 as defined in SEQ ID NO:23; MPK-5 as defined in SEQ ID NO:24; CPK-1 as defined in SEQ ID NO:25; and CPK-2 as defined in SEQ ID NO:26.
15. The isolated PHSRP coding nucleic acid of Claim 14, wherein the PKSRP coding nucleic acid hybridizes under stringent conditions to a sequence of SEQ ID NO:14, SEQ ID NO:15, SEQ ID NO:16, SEQ ID NO:17, SEQ ID NO:18, SEQ ID NO:19, SEQ ID NO:20, SEQ ID NO:21, SEQ ID NO:22, SEQ ID NO:23, SEQ ID NO:24, SEQ ID NO:25, or SEQ ID NO:26.
16. An isolated recombinant expression vector comprising a nucleic acid of Claims 14 or 15, wherein expression of the vector in a host cell results in increased tolerance to environmental stress as compared to a wild type variety of the host cell.
17. A method of producing a transgenic plant containing a Protein Kinase Stress-Related Protein (PKSRP) coding nucleic acid, wherein expression of the nucleic acid in the plant results in increased tolerance to environmental stress as compared to a wild type variety of the plant, comprising, transforming a plant cell with an expression vector comprising the nucleic acid, generating from the plant cell a transgenic plant with an increased tolerance to environmental stress as compared to a wild type variety of the plant, wherein the PKSRP is selected from the group consisting of Protein Kinase-6 (PK-6); Protein Kinase-7 (PK-7); Protein Kinase-8 (PK-8); Protein Kinase-9 (PK-9); Casein Kinase homologue (CK-1); Casein Kinase homologue-2 (CK-2); Casein Kinase homologue-3 (CK-3); MAP Kinase-2 (MPK-2); MAP Kinase-3 (MPK-3); MAP Kinase-4 (MPK-4); MAP Kinase-5 (MPK-5); Calcium dependent protein kinase-1 (CPK-1); Calcium dependent protein kinase-2 (CPK-2); and orthologs thereof.
18. The method of Claim 17, wherein the PKSRP is selected from the group consisting of PK-6 as defined in SEQ ID NO:27; PK-7 as defined in SEQ ID NO:28; PK-8 as defined in SEQ ID NO:29; PK-9 as defined in SEQ ID NO:30; CK-1 as defined in SEQ ID NO:31; CK-2 as defined in SEQ ID NO:32; CK-3 as defined in SEQ ID NO:33; MPK-2 as defined in SEQ ID NO:34; MPK-3 as defined in SEQ ID NO:35;

MPK-4 as defined in SEQ ID NO:36; MPK-5 as defined in SEQ ID NO:37; CPK-1 as defined in SEQ ID NO:38; and CPK-2 as defined in SEQ ID NO:39.

19. The method of Claim 17, wherein the PKSRP coding nucleic acid is selected from the group consisting of PK-6 as defined in SEQ ID NO:14; PK-7 as defined in SEQ ID NO:15; PK-8 as defined in SEQ ID NO:16; PK-9 as defined in SEQ ID NO:17; CK-1 as defined in SEQ ID NO:18; CK-2 as defined in SEQ ID NO:19; CK-3 as defined in SEQ ID NO:20; MPK-2 as defined in SEQ ID NO:21; MPK-3 as defined in SEQ ID NO:22; MPK-4 as defined in SEQ ID NO:23; MPK-5 as defined in SEQ ID NO:24; CPK-1 as defined in SEQ ID NO:25; and CPK-2 as defined in SEQ ID NO:26.
20. The method of Claim 17, wherein the PKSRP coding nucleic acid hybridizes under stringent conditions to a sequence of SEQ ID NO:14, SEQ ID NO:15, SEQ ID NO:16, SEQ ID NO:17, SEQ ID NO:18, SEQ ID NO:19, SEQ ID NO:20, SEQ ID NO:21, SEQ ID NO:22, SEQ ID NO:23, SEQ ID NO:24, SEQ ID NO:25, or SEQ ID NO:26.
21. A method of modifying stress tolerance of a plant comprising, modifying the expression of a Protein Kinase Stress-Related Protein (PKSRP) in the plant, wherein the PKSRP is selected from the group consisting of Protein Kinase-6 (PK-6); Protein Kinase-7 (PK-7); Protein Kinase-8 (PK-8); Protein Kinase-9 (PK-9); Casein Kinase homologue (CK-1); Casein Kinase homologue-2 (CK-2); Casein Kinase homologue-3 (CK-3); MAP Kinase-2 (MPK-2); MAP Kinase-3 (MPK-3); MAP Kinase-4 (MPK-4); MAP Kinase-5 (MPK-5); Calcium dependent protein kinase-1 (CPK-1); Calcium dependent protein kinase-2 (CPK-2); and orthologs thereof.
22. The method of Claim 21, wherein the PKSRP is selected from the group consisting of PK-6 as defined in SEQ ID NO:27; PK-7 as defined in SEQ ID NO:28; PK-8 as defined in SEQ ID NO:29; PK-9 as defined in SEQ ID NO:30; CK-1 as defined in SEQ ID NO:31; CK-2 as defined in SEQ ID NO:32; CK-3 as defined in SEQ ID NO:33; MPK-2 as defined in SEQ ID NO:34; MPK-3 as defined in SEQ ID NO:35; MPK-4 as defined in SEQ ID NO:36; MPK-5 as defined in SEQ ID NO:37; CPK-1 as defined in SEQ ID NO:38; and CPK-2 as defined in SEQ ID NO:39.
23. The method of Claim 21, wherein the PKSRP coding nucleic acid is selected from the group consisting of PK-6 as defined in SEQ ID NO:14; PK-7 as defined in SEQ ID NO:15; PK-8 as defined in SEQ ID NO:16; PK-9 as defined in SEQ ID NO:17; CK-1 as defined in SEQ ID NO:18; CK-2 as defined in SEQ ID NO:19; CK-3 as defined in

SEQ ID NO:20; MPK-2 as defined in SEQ ID NO:21; MPK-3 as defined in SEQ ID NO:22; MPK-4 as defined in SEQ ID NO:23; MPK-5 as defined in SEQ ID NO:24; CPK-1 as defined in SEQ ID NO:25; and CPK-2 as defined in SEQ ID NO:26.

24. The method of Claim 21, wherein the PKSRP coding nucleic acid hybridizes under stringent conditions to a sequence of SEQ ID NO:14, SEQ ID NO:15, SEQ ID NO:16, SEQ ID NO:17, SEQ ID NO:18, SEQ ID NO:19, SEQ ID NO:20, SEQ ID NO:21, SEQ ID NO:22, SEQ ID NO:23, SEQ ID NO:24, SEQ ID NO:25, or SEQ ID NO:26.
25. The method of Claim 21, wherein the stress tolerance is decreased.
26. The method of Claim 21, wherein the plant is not transgenic.
27. The method of Claim 21, wherein the plant is transgenic.
28. The method of Claim 27, wherein the plant is transformed with a promoter that directs expression of the PKSRP.
29. The method of Claim 28, wherein the promoter is tissue specific.
30. The method of Claim 28, wherein the promoter is developmentally regulated.
31. The method of Claim 21, wherein PKSRP expression is modified by administration of an antisense molecule that inhibits expression of PKSRP.

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